

IMMIGRATION AND EXPANSION OF THE NEW ENGLAND FLORA

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ABSTRACT. Nonindigenous vascular plant species have been introduced, intentionally or unintentionally, since Europeans landed in what is now New England some time in 1496. We know little about the native flora of New England at that time. John Josselyn's *New England Rarities Discovered* recorded both the native and European plants he saw during his two visits to southeastern Maine and is the earliest report on the flora of what is now New England. Subsequent writers, such as Manasseh Cutler, also documented both the native and increasing number of non-native species that became naturalized in this region. This paper discusses both the intentional and unintentional introductions from Europe and the later introductions from eastern Asia. Various modes of unintentional introductions such as ballast plants and agricultural "stowaways" are presented. Species that are native to other regions of North America and that have naturalized in New England are mentioned. Currently, over 1000 vascular plant species that are not considered indigenous to the region exist in the New England flora. A few introductions have become so aggressive in their establishment around New England that they are now acknowledged as invasive species. Early botanical works and herbarium records are used here to document arrivals and changes in the flora.

Key Words: introductions, non-native plants, nonindigenous plants, New England, flora

The flora of New England is a mosaic of native and non-native species. The ratio of native to non-native species varies from habitat to habitat, site to site, and time to time. Nonindigenous species have been arriving since the earliest European explorers set foot on New England shores. While some non-native species arrived accidentally, many were brought here for utilitarian or aesthetic reasons. Not surprisingly, the earliest introductions into New England were native to Europe, later ones coming from other regions of North America, Eurasia, Eastern Asia, or elsewhere.

The current New England flora is composed of between 24 to 45 percent nonindigenous species (Table 1). These percentages are only approximations because of different taxonomic circum-

Table 1. Tabular summary of species by state. ¹Seymour 1969; ²Dowhan 1979, Mehrhoff 1987, 1995; ³Gould et al. 1998; ⁴Sorrie and Somers 1999; ⁵Campbell et al. 1995.

| State/Region | Total spp. | Native spp. | Non-native spp. | Percent Non-native |
|----------------------------|------------|-------------|-----------------|--------------------|
| New England ¹ | 2882 | 1995 | 887 | 31% |
| Connecticut ² | 2625 | 1700 | 925 | 35% |
| Rhode Island ³ | 1618 | 1226 | 392 | 24% |
| Massachusetts ⁴ | 2814 | 1538 | 1276 | 45% |
| Maine ⁵ | 2103 | 1469 | 634 | 30% |

scriptions, nomenclature, different appraisals of what is considered naturalized, and recent discoveries. Published works vary depending on nomenclatural sources. Seymour's *Flora of New England* (Seymour 1969) and Dowhan's *Checklist for Connecticut* (Dowhan 1979) follow Fernald's nomenclature (Fernald 1950) for most treatments. The *Vascular Flora of Rhode Island* (Gould et al. 1998) follows Cronquist (Gleason and Cronquist 1991) and *Flora of North America* (Flora of North America Editorial Committee 1993+). Massachusetts' county checklist (Sorrie and Somers 1999) follows a mixture of Kartesz's nomenclature (Kartesz 1994) and that of the Flora of North America Project (Flora of North America Editorial Committee 1993+). Maine's checklist (Campbell et al. 1995) uses a variety of additional sources including experts who are preparing taxonomic treatments for the Flora of North America Project.

In New England, Rhode Island appears to have the lowest percentage of nonindigenous species, 24% (Gould et al. 1998), while Massachusetts appears to have the highest, 45% (Sorrie and Somers 1999). Published current figures are not available for Vermont or New Hampshire.

There are two complimentary ways of evaluating the history of the nonindigenous components of the New England flora. One way of approaching the expansion of the flora is temporal. The other is phytogeographic. Historical documents shed light on the increase in non-native species over time. Concurrently, there are elements of the introduced flora known to represent different phytogeographic origins. Although there were periods of introductions from different geographical regions, the temporal component and the phytogeographic component do not exactly coincide. Separating the two can be difficult because certain Asian taxa,

such as Tree-of-Heaven, *Ailanthus altissima* (Mill.) Swingle, were introduced into North America from botanic gardens in Europe (Spongberg 1990).

TERMINOLOGY

For this paper I set the bounds of New England to be the cumulative political boundary of the six New England states. While this boundary is admittedly artificial, it helps clarify the meaning of the native and non-native.

Native or indigenous are used here for those species that existed within this boundary prior to AD 1496 when the Italian explorer John Cabot, sailing for King Henry VII of England, landed on what are now New England shores (Newby 1982). Native taxa are often mentioned in the early botanical literature for New England. Herbarium collections do not exist that document these early reports. In fact, the earliest herbarium collections for New England that still exist (at least in North American herbaria) appear to be from around the beginning of the 19th century. Most native taxa are North American endemics although some exhibit amphiatlantic or cosmopolitan distributions. Taxa that naturally occurred in the region near New England and recently arrived here by means of their own adaptations without the aid of human intervention are also considered native. *Eupatorium album* L., is considered native to Connecticut although it was only discovered there in 1981 (Mehrhoff 1996). It had been known for many years from Long Island (Miller and Young 1874) and is wind dispersed. Its discovery in southeastern Connecticut was not surprising.

Non-native or nonindigenous species as used here are taxa that appear to have arrived in New England sometime after AD 1500. Most of these are known to have extra North American origins. The majority of these taxa arrived with aid, intentional or accidental, from humans. As many species were intentionally introduced and subsequently escaped and became established here, there is often a known history of their introduction. In addition, many of these are known to be native elsewhere and their occurrence here accepted as human-assisted. There are no herbarium records until much later and often, as a newly discovered species is noteworthy, there may be numerous collections attesting to its recent discovery and novelty.

Introduction is used to describe an event. By itself it implies neither intentional introduction nor accidental introduction. These modifiers should be used when the history of an introduction is known or clarity of thought is necessary.

Naturalized is used to designate non-native taxa that are established, reproducing and persisting without human intervention and cultivation. Often, establishment can occur within natural plant communities. Many non-native taxa occur in New England but cannot be considered as naturalized because they must have human intervention in order to persist. Further, naturalized implies persistence over time. Some species not considered naturalized may exist away from cultivation for a year or two but populations do not establish and persist for long. These should be considered adventive (Fernald 1950).

Garden escapes are those taxa that originally were intentionally introduced as garden plants and subsequently became naturalized away from cultivation. The term garden escape here is used only for taxa that are completely naturalized into the New England flora, not for adventives. Notations on old herbarium specimens often indicate “in garden,” “near garden,” “escaped from garden,” or “established.”

Occasionally perceptions of a plant’s desirability change when a garden plant escapes and becomes naturalized away from gardens. Fernald (1940) tells how *Hieracium aurantiacum* L. was a prized garden plant in the central Maine of his youth and was then known as Venus’ Paint-brush. Once it had escaped and become established away from gardens it was often seen growing aggressively in these new sites. After a while, its colloquial name had changed to Devil’s Paint-brush.

Invasion, invasive species, and invasives are used to imply both an arrival event and subsequent establishment and proliferation. These terms are only used here in reference to non-native species. Rapid spread or aggressive growth and proliferation are implicit with invasive species. No inference should be drawn about the arrival event; it can either be by the biological attributes of the species or with human assistance. The use of explosive species or native explosive species in reference to native species that exhibit the characteristics of invasive species might help avoid confusion.

A weed, commonly described as a plant growing where it is not wanted, can be native or non-native (Les and Mehrhoff 1999).

For this reason, and because personal preferences and biases exist, the term weed is not used here. Weedy, however, is a good descriptive term and clearly understood by most to imply rampant growth.

Nomenclature used here follows Cronquist (Gleason and Cronquist 1991) or the published volumes of the Flora of North America Project (Flora of North America Editorial Committee 1993+).

HISTORY OF INTRODUCTIONS

Early accounts of the pre-colonial flora are biased by interpretation (Whitney 1994) and rarely go beyond generic descriptions of the forest. The earliest written account of the flora was that of John Josselyn, an Englishman who published two books on the natural curiosities of the New World in the late 17th century. No one knows the dates of Josselyn's birth or death but we do know he twice visited his brother who lived in the region that is now Saco, Maine. The first visit was in 1638, when he stayed for 15 months. His second visit was in 1663, this time lasting for eight years (Tuckerman 1865). During these two visits he recorded his observations on the wildlife and flora he encountered. Shortly after his return to England in 1671, he published *New England Rarities Discovered in Birds, Beasts, Fishes, Serpents, and Plants of that Country* (Josselyn 1672).

In *New England Rarities Discovered*, Josselyn, as the title suggests, discussed five groups of organisms found in New England. Within the plants, he further divided his listings into five subdivisions: "Of such Plants as are Common with us in England," "Of such Plants as are proper to the Country," "Of such Plants as are proper to the Country, and have no Name," "Of such Plants as have sprung up since the English planted and kept Cattle in New England," and "of such Garden-Herbs amongst us as do thrive there, and of such as do not" (Josselyn 1672). Interspersed throughout the text are uses for the plants and animals about which he was writing. The author, with crude line drawings, illustrated nine of the plants. Josselyn's use of vernacular names is often confusing or difficult to decipher. He probably used Johnson's edition of Gerard's Herbal from 1636 as his source of information (Tuckerman 1865).

New England Rarities Discovered represents the first exposition of the New England Flora. In addition, it sets a benchmark

for dates for early nonindigenous introductions. Josselyn's fifth section on plants is of interest as a list of garden plants that may represent one of the earliest accounts of what plants were cultivated for food by early settlers.

Josselyn's first section, "Of such Plants as are Common with us in England" includes native widespread species such as *Typha latifolia* L. that naturally occurred here as well as in Great Britain. Other taxa included in this first list are now considered to have conspecific species on either side of the Atlantic. Josselyn included here a number of species now considered nonindigenous in New England. One can infer, as Tuckerman (1865) did, that these nonindigenous taxa must have been introduced early in colonial history because they were so well established by the time of his visits that Josselyn mistook them for natives.

Josselyn used vernacular names known to him. Some of these such as "Hollow-leaved Lavender" (*Sarracenia purpurea* L.), "Rupter-wort" (*Euphorbia* sp.), or "Trackle-berries" [*Smilacina racemosa* (L.) Desf.] are no longer used (Tuckerman 1865). It is often difficult to decide which taxon was meant by some of Josselyn's names. In 1865, Edward Tuckerman published an annotated version of *New England Rarities Discovered*. In this, he attempted to identify, using contemporary scientific names, all of the taxa included by Josselyn. Tuckerman's interpretations are extremely helpful though he was not always clear about the species to which Josselyn was referring. He attempted to interpret Josselyn's names in light of what was known about European and North American floristics at that time. For example, Tuckerman assumed that when Josselyn recorded St. John's-wort, he probably meant *Hypericum perforatum* L., now assumed by most botanists to be introduced here. However, he commented that Josselyn could have meant *Hypericum corymbosum* Muhl. (now *Hypericum punctatum* Lam.).

Josselyn's fourth section, "Of such Plants as have sprung up since the English planted and kept Cattle in New England," is the most interesting section when considering the nonindigenous flora. Here Josselyn listed 40 species that he felt were not native to New England and were brought here, intentionally or unintentionally, by Europeans. His section heading is interesting in that it implies he associated the keeping of cattle with the arrival of European species. Seeds of many species are known to have been "stowaways" with seeds intended for agricultural uses (Fernald

1905). Perhaps Josselyn had some reason to suspect that seeds were unintentionally introduced with livestock food or bedding. In a footnote following this section Tuckerman pointed out taxa mentioned mostly in Josselyn's first section that belong here.

The first and fourth parts of Josselyn's plant lists are of interest as lists of plants that had been introduced from the Old World by this time. These lists help narrow the period during which the taxa Josselyn included here were introduced. Given the state of floristic botany in the late 17th century, it is not surprising Josselyn included with his native species, taxa now thought to be introductions. For instance, Josselyn's Wild purcelane [*sic*], was thought by Tuckerman (1865) to be *Portulacca oleracea* L., a native of Europe. This report establishes this taxon as part of the flora of New England at a very early date. Josselyn's inclusion of Herb Robert in his first section is interesting. *Geranium robertianum* L. was considered by Tuckerman (1865) to be "common to us and Europe". Eastern North American populations have been viewed as native here by Fernald (1950) but naturalized by Cronquist (Gleason and Cronquist 1991). Many field botanists consider it a good indicator of rich, shaded colluvial slopes and cool, mesic woodlands. In western North America populations of *G. robertianum* are viewed as non-native and invasive (Brumbach, pers. comm.). Josselyn's inclusion of this species in this section suggests it should be considered to be native in New England since it is unlikely it would have become so well established in such specific natural habitats in the short time after Europeans arrived here.

The second written record of plants, both native and non-native, existing in New England, is that of Manasseh Cutler. Cutler was born in Killingly, Connecticut, in 1742, educated at Yale College, and became a pastor in Ipswich Hamlet, Massachusetts, where he lived until his death in 1823 (Humphrey 1898). In spite of remaining in one town for 52 years, Cutler was far from sedentary. We know from his correspondence and diaries (Cutler and Cutler 1888) that he traveled widely throughout New England, collecting as he traveled. A diary entry from July 2, 1787 recounts how while traveling from Middletown, Connecticut, to New Haven he examined several plants he had collected, "for the heat was too intense for riding" (Cutler and Cutler 1888). Unfortunately, Cutler's large herbarium was destroyed by fire (Day 1901).

Cutler's "An Account of some of the vegetable Productions, naturally growing in this Part of America, botanically arranged [*sic*]" was published in the first volume of the Memoirs of the nascent American Academy of Arts and Sciences (Cutler 1785). "Botanically arranged" was according to the new Linnaean sexual system. In his introductory paragraphs, Cutler (1785) explained that he undertook this listing of plants from "this part of America" because he felt that while "*Canada* and the southern states . . . have been visited by eminent botanists from *Europe*" there had been "almost total neglect of botanical enquiries [*sic*], in this part of the county". He blamed this on the fact "*that Botany has never been taught in any of our colleges, and to the difficulties that are supposed to attend to it; but principally to the mistaken opinion of its inutility in common life*" [his italics]. Later he commented, "From the want of botanical knowledge, the grossest mistakes have been made in the application of the *English* names of *European* plants, to those of *America*." Cutler was well aware of nonindigenous plants in the landscape. On this subject he wrote, "We have it, also, in our power, from the recent settlement of the country, to determine, with great certainty, what vegetable productions are indigenous, and present those doubts and disputes hereafter, which have frequently taken place among botanist in old countries. For it is very improbable that any exotic plants are become so far naturalized as not to be distinguishable from the natives."

Cutler reported 66 European species established in New England. He made no attempt to correct the confusion of using European names for North American taxa. Because of this, some of his taxa must be suspect. Under *Ornithogalum*, he said about what he called Bethlemstar [*sic*], "Blossoms yellow. Common in grass lands and amongst bushes." The European *O. umbellatum* L., now commonly known as Star-of-Bethlehem, has white tepals. The native *Hypoxis hirsuta* (L.) Coville, common in New England grasslands and open woods, has yellow sepals and petals and was originally published as *Ornithogalum hispidum* by Linnaeus.

Possibly the most interesting inclusion is under the genus *Cardamine*. Cutler gave the common names "Impatient" and then "Impatient Ladysmock". These are followed by the comments, "Blossoms yellowish white. By springs in mountainous land." The European *C. impatiens* L. has yellowish-white petals whereas

most other *Cardamine* that occur in New England have white or pinkish petals. The earliest herbarium specimen seen from New England was collected in Peterborough, New Hampshire, in 1916. It seems unlikely *C. impatiens* was here and established in Cutler's time as it is not included in the seventh edition of *Gray's Manual* (Robinson and Fernald 1908) and the eighth edition of *Gray's Manual* (Fernald 1950) has it only as local from southern New Hampshire and eastern Pennsylvania. It is possible, but unlikely, that Cutler was seeing *C. hirsuta* L. but this species was not known in New England until recently. *Cardamine parviflora* L. is native to Europe and represented in New England by its var. *arenicola* (Britt.) O. E. Schulz, but this is usually a taxon of dry, sandy soils and ledges, not of "springs in mountainous land". Cutler was probably reporting the native *C. pensylvanica* Muhl. that occurs commonly along streams, though this species usually has sharply white petals. The true identity of this taxon and its historical biogeography must await further elucidation.

Some of Cutler's other inclusions are less obscure. Many notes about non-native species are interesting in light of current distributions. *Ligustrum* "is not very common in the wild state." He made no mention of which species, but it must have been, given the time, the European Common Privet *L. vulgare* L. Thornapple or Jimsonweed, *Datura stramonium* L. "is said to be an exotic, and that it is not found growing at any great distance from the sea." *Solanum dulcamara* L. was "Common about fences in moist land." *Berberis*, taken by me to be *B. vulgaris* L. because of his comments "that rye and wheat will be injured by this shrub, . . ." is said to be "Common".

The next account of the region's flora was Jacob Bigelow's *Florula Bostoniensis* or *Plants of Boston* published in 1814. Bigelow included 83 introduced species in the first edition. By the third edition, published in 1840, there are 140 nonindigenous plants enumerated (Fernald 1905). In most cases, nonindigenous species are not distinguished in the text. Occasionally an entry will include a comment about a possible introduction. By the time the second edition was published in 1824, the Black Locust, *Robinia pseudoacacia* L. had become established in New England. Not included in the first edition of *Plants of Boston*, Bigelow said of it by 1824, "The Locust tree, exceedingly valued for the hardness and durability of its timber, is not, I believe, found native in the New England states, though abundantly naturalized near hab-

itations and roads.” He went no further than to explain that it is native to North America. It is commonly taken to have occurred as far east and north as central Pennsylvania (Elias 1987). This is indicative however, that by this time, people had started moving species native to other parts of North America into New England for utilitarian purposes.

Other floras produced in the first half of the 19th century add other species to the growing list of non-native species that had naturalized in New England. John Brace’s flora of Litchfield, Connecticut (Brace 1822), includes both native and non-native species. Likewise, in 1831, Dr. Eli Ives, a professor of *materia medica* at Yale College, produced a list of plants growing without cultivation in the vicinity of New Haven, Connecticut (Ives et al. 1831). Both authors included native and non-native taxa but did not always distinguish between them.

The Massachusetts legislature commissioned a report on the botany of the Commonwealth that was ultimately separated into herbaceous plants by Chester Dewey (1840) and trees and shrubs by Emerson (1846). While Dewey’s flora includes introductory remarks under the heading “Of the Useless Plants” that would lead one to believe he might have provided insight into some of the introductions, he actually provided little beyond commenting that a species is introduced, possibly introduced, or naturalized. Similarly, Emerson included nonindigenous species but shed no light on how they might have been introduced. These points apparently show, however, that while cognizant of the presence of non-native species, these botanists did not view them in a negative light.

Many collections made during this same period led to the naming of species of vascular plants from New England that were new to floristic botany. It is interesting to note that the scientific authorities for most of the taxa included in the early works on the New England flora were Europeans. During the first half of the 19th century, names of New Englanders such as Bigelow, Ives, Oakes, Robbins, Hitchcock, and Dewey appeared as authorities for New England plants. The species published by these botanists added to the numerical expansion of the regional flora.

By the last half of the 19th century lists of non-native plants by means of introduction were appearing in the literature. There are a number of plausible explanations for this beyond the scope of this paper, such as better communication between Europe and

North America, better training in botany, and botanists who traveled abroad and knew plants in native habitats as well as in their naturalized condition. Perhaps, too, there was an increase in the number of North American botanists, both professional and amateur, who were actively cataloging the local flora.

The effort of cataloging non-native species was perhaps pioneered by Lewis D. de Schweinitz, whose "Remarks on the Plants of Europe which have become naturalized in a more or less degree, in the United States" was published posthumously in 1832 (Schweinitz 1832). Schweinitz's work appears to have focused primarily on New York and Pennsylvania. He separated the 137 species he enumerated into 3 categories: 1) Plants which have become more or less *generally* naturalized in the United States; 2) Plants but *partially* spread; and 3) Introduced only in the vicinity in which they are or were cultivated. He further divided the more or less generally naturalized species into those introduced by cultivation, for agricultural or other purposes, and those introduced fortuitously with agricultural seeds (Schweinitz 1832).

SOURCES OF INTRODUCED PLANTS

Introductions occurring in the latter half of the 19th century were either intentional or unintentional. Plants were intentionally introduced as crops for humans or livestock, for natural products such as dyes, foods, and other intentional uses, or for esthetic reasons. Often these escaped and became naturalized. Robinson (1880), in the introduction to *The Flora of Essex County*, told of the prevalence of gardens for purely ornamental purposes. It is in this period that we see the rise of botanical gardens that served the multiple functions of education, research, and recreation. Noteworthy among these was Harvard's Botanical Garden in Cambridge, begun in 1806 by William Dandridge Peck and taken over by Asa Gray in 1842 (Dupree 1959), and later, in 1872, the Arnold Arboretum (Hay 1995; Spongberg 1990). During this period, the polymath Jacob Bigelow and others laid out the grounds of Mt. Auburn Cemetery in Cambridge as a kind of botanical garden.

Seed catalogs show that many non-native plants had been introduced into the trade during the first half of the 19th century (Mack 1991). Many well-known naturalized species were first

introduced into New England as garden plants and later escaped. Sometimes these “escapes” were aided by plant-growers. Both *Trapa natans* L. and *Marsilea quadrifolia* L. were introduced into the wild near Boston by Louis Gauerineau, the gardener at Harvard’s Botanical Garden (Les and Mehrhoff 1999). Other times, garden plants escaped. Many early labels for collections of *Vincetoxicum nigrum* (L.) Moench mention it as escaping from gardens. It is interesting to speculate that the source of the first New England specimen of this Swallowwort (BRU!), taken on the streets of Cambridge, Massachusetts, in 1876, was the Harvard Botanical Garden. Fernald (1900) explained how *Artemisia stelleriana* Besser probably escaped from late 19th century private gardens in which it was a popular bedding plant.

Ship’s ballast was an early-recognized source of non-intentional introductions. Ships coming to the United States in order to bring natural resources back to Europe would arrive with rocks and dirt as ballast to be discarded before loading the valuable cargo for the return trip. Many port cities had “ballast grounds” or ballast piles to which the jettisoned ballast would be continually added. These became favorite haunts of local botanists in search of floristic novelties. One of the earliest works on this subject was by Aubrey H. Smith on “Colonies of Plants observed near Philadelphia” (Smith 1867). This was followed by other reports from the Philadelphia area (Burk 1877; Martindale 1876, 1877). In 1878, Judge Addison Brown began a series of five articles on ballast plants collected around the port of New York City (Brown 1878a, 1878b, 1879, 1880, 1881). Many of the plants, especially in Brown’s lists for New York, occur in New England and it is not inconceivable that they arrived here in the same manner, given the thriving ports and navy yards along the coast from Connecticut to Boston and downeast to Maine. In fact, Smith (1867) referred to some of the ballast piles in Philadelphia near where the “coasters” docked.

In the early part of the 20th century a number of small papers were produced on plants found in the vicinity of factories where seeds or propagules would be introduced with the products with which the factory dealt. Some of the best known of these kinds of introductions were the plants found with “wool-waste”. From 1901 to 1932 there were a series of articles in *Rhodora*, mostly by Emily F. Fletcher, dealing with plants found around woolen processing plants near Westford, Massachusetts (Collins 1901;

Fletcher 1912, 1913, 1915, 1916, 1917; Weatherby, 1924, 1932). The composting wool-waste was later used to fertilize fields (Fernald 1905).

Robinson (1880) mentioned introduced plants found along the Merrimac [*sic*] River down-stream from Lowell and Lawrence. An interesting group of non-native species was collected from the waste pile of a rubber reprocessing plant in Waterbury, Connecticut (Blewitt 1911, 1912). Apparently, used shoes were collected for rubber reclamation. The nonrubber parts were thrown on the waste piles where seeds that had hitchhiked there germinated and grew. In an interesting postscript that may explain why some of these species did not persist, Blewitt said, "For the past two years many plants in a portion of this place have been killed by fumes of an acid factory while those that survive are badly seared and burned by the deadly gases" (Blewitt 1911).

One of the most interesting cases of "factory-flora" was the discovery of *Lepidium latifolium* L. on the grounds of a glue factory in Danvers (Morse 1924). This European species is now abundant in parts of the southwest. In New England, it was found in eastern Massachusetts near the coast and at one inland site in Worcester County. It also occurs along the southwestern Connecticut coastline where it was thought to have been introduced at the site of a "dye and licorice works" (Eames 1935). In addition, *Paulownia tomentosa* (Thunb.) Steud., *Lepidium draba* L., and *Tamarix pentandra* Pall. were reported from the same area.

Railroads brought adaptable species, often ones with weedy tendencies, from the developing west. The now near ubiquitous Black-eyed Susan, *Rudbeckia hirta* L., is thought to have come east in that fashion. It had reached Philadelphia by 1826 and probably New England by 1855 (Robinson 1880). Fernald (1905) felt that *Senecio jacobea* L. arrived in Portland by way of the railroad from New Brunswick.

Unintentional introductions and the escape of intentional introductions continue. *Froelichia gracilis* (Hook.) Moq., having reached New England by railroads, was first collected here in 1973. Although not currently known from New England, Mile-a-minute vine, *Polygonum perfoliatum* L., was first reported in Westchester County, New York, in 1995 (R. Mitchell, pers. comm.). At that time it was well established and within a mile of Connecticut. It seems plausible, since a natural dispersal from the nearest known occurrence in eastern Pennsylvania was un-

likely, that it arrived here at this site in nursery stock and escaped. *Lonicera maackii* (Rupr.) Maxim. was first collected in the wild in Connecticut in 1978. This species is occasionally cultivated and it is likely, given its history as an invasive species in the Midwest (Luken and Theiret 1996), that its numbers will increase in the wild in southern New England.

BIOGEOGRAPHY OF PLANT INTRODUCTIONS

An equally informative way of looking at introductions is by considering species from different geographic origins. Most of the early introductions were of European plants that arrived with or after the earliest settlers (Fernald 1905). This continued until the opening of eastern Asia for trade after 1861 (Rehder 1936). After this, while it is still likely that some European plants were introduced into New England, most of the new introductions were from regions in East Asia such as Japan and China (Spongberg 1990). As they came from similar climates and geological histories, species from East Asia were well adapted to exist in New England. Often imported as ornamentals, some of these escaped and became quickly established in the local flora.

Again, the botanical gardens often provide the earliest records for introduced plants. In New England, the Arnold Arboretum was actively involved in plant importations from Japan and China by the beginning of the 20th century (Hay 1995; Rehder 1936). Rehder (1936) reported that after 60 years, the Arnold Arboretum had introduced at least 2500 species from around the world. Progeny of many of these reached American gardens.

A catalog of plants in the Harvard Botanical Garden, thought to have been written in 1879 (J. Warnement, pers. comm.), includes both *Elaeagnus umbellata* Thunb. and *Berberis thunbergii* DC. Although both are now considered highly invasive, at that point they were well-behaved members of the Garden's holdings. As with many invasive species, there is a variable period after introduction before offspring begin to appear in the wild.

Recent introductions from East Asia were not seen as a problem in 1905 when M. L. Fernald delivered his address on "Some Recently Introduced Weeds" to the Massachusetts Horticultural Society (Fernald 1905). Fernald stated that the number of non-indigenous plants in New England was then over 600 species. Further, he discussed only European species in spite of the fact

that East Asian species had been introduced by that time (Rehder 1936). Later, in a presentation to the Franklin Society in 1939 (Fernald 1940) Fernald devoted a number of pages to the problems faced by rare plants from aggressive non-native species. One can infer from these two papers that in 1905 most Asian species were hardly, if at all, dispersing away from managed landscapes into the wild but that by 1939, many of the East Asian species were escaping and becoming well established in the wild.

CONCLUSIONS

The New England flora has steadily grown since the arrival of Europeans in the 17th century. While many species were intentionally introduced for utilitarian reasons some were also intentionally introduced for aesthetics. Many arrived unintentionally. These unintentional means of transport were often quite varied. Many, but not all species, persisted and are part of our regional flora today. Others that may or may not have become naturalized did not persist until present. As recently as the middle of this century, nonindigenous species were being imported as foods, medicines, or ornament (Rehder 1936). In addition, still other species, considered native to adjacent regions, have naturally expanded their ranges into New England. The most recent comprehensive list of New England vascular flora says there are 2882 vascular plant species reported from New England (Seymour 1969). Of these, 887 are considered nonindigenous (Seymour 1969). Given recent finds and the different nomenclature, these figures must only be accepted as approximations and it is likely that over 1000 species should be considered naturalized here.

Introductions can be looked at both from a historic perspective and a phytogeographic perspective. While these approaches compliment each other, clear divisions in each cannot be drawn. *Rosa multiflora* Thunb., a native of eastern Asia, was first introduced into the Elgin Botanic Garden in New York by way of European botanical gardens in 1811 (Rehder 1936).

Currently, the few non-native species that are aggressively invading natural plant communities are of paramount concern for conservationists (Brumback 1998). These invasive species are well known and exhibit biological characteristics of species adapted to habitat disturbance (Mehrhoff 1998). Efforts must be taken to control their spread. Concurrently, there are other non-

native species that have the potential of becoming invasive in New England and their status must be assiduously monitored.

One final note: times have changed since Manasseh Cutler lamented how few botanists studied the New England flora (Cutler 1785). We know as much about our flora as we do because, for years botanists combing the fields, woods, and other habitats traipsed all over New England. Now there again seems to be a paucity of field botanists. Whether you ascribe to Eames (1935) who “had the good fortune . . . to find great quantities” of *Lepidium latifolium* or to Morse (1924) who sensed that the same species “seems to be liable to become a hardy weed of undesirable character” is not the point. What is important is that these two individuals had the ability and interest to recognize something new, to identify it, and to document its occurrence by collecting herbarium specimens. If we want to continue to monitor changes in the New England flora we must have botanists in the field to do so.

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